Perspective

Sanitation Systems (/perspective/sanitation-systems-perspective)

Section

Sanitation Technologies (/sanitation-systems/sanitation-technologies)

Factsheet

Conventional Gravity Sewer

العربية (/ar/sanitation-systems/sanitation-technologies/conventional-gravity-sewer)

Applicable to

System 8 (/humanitarian-crises/urban-settings/sanitation/sanitation-systems/system-8%3A-blackwater-transport-to-%28semi-%29-centralized-treatment-system)

System 9 (/sanitation-systems/sanitation-systems/system-9%3A-sewerage-system-with-urine-diversion)

Application level

- [x] City
- [ ] Household
- [x] Neighborhood

Management level

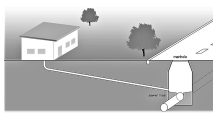
- [ ] Household
- [x] Public
- [ ] Shared

Inputs

- Stormwater
- Blackwater
- Brownwater
- Greywater

Outputs

- Stormwater
- Blackwater
- Brownwater
- Greywater



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Executive Summary

Conventional gravity sewers are large networks of underground pipes that convey blackwater, greywater and, in many cases, stormwater from individual households to a (Semi-) Centralized Treatment facility, using gravity (and pumps when necessary).

Advantages

- Less maintenance compared to simplified and solids-free sewers
- Greywater and possibly stormwater can be managed concurrently
- Can handle grit and other solids, as well as large volumes of flow

Disadvantages

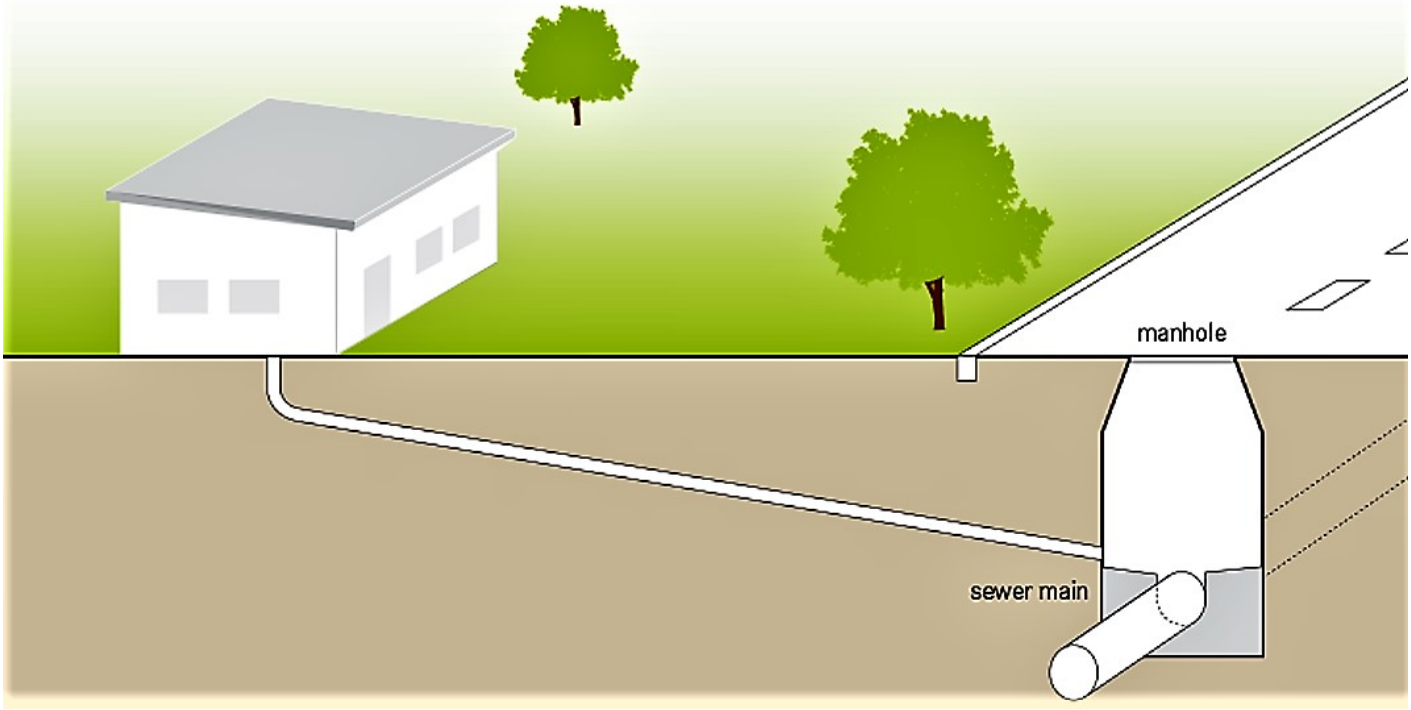
- Very high capital costs; high operation and maintenance costs
- A minimum velocity must be maintained to prevent the deposition of solids in the sewer
- Requires deep excavations
- Difficult and costly to extend as a community changes and grows
- Requires expert design, construction and maintenance
- Leakages pose a risk of wastewater exfiltration and groundwater infiltration and are difficult to identify

In	Out
Precipitation, Blackwater, Faecal Sludge, Greywater, Brownwater, Urine, Faeces, Non-biodegradable Wastewater	Blackwater, Non-biodegradable Wastewater

Introduction

The conventional gravity sewer system is designed with many branches. Typically, the network is subdivided into primary (main sewer lines along main roads), secondary and tertiary networks

(networks at the neighbourhood and household level).



Schematic of a Conventional Gravity Sewer. Source: TILLEY et al. (2014)

Design Considerations

Conventional gravity sewers normally do not require onsite pre-treatment, primary treatment or storage of the household wastewater before it is discharged. The sewer must be designed, however, so that it maintains self-cleansing velocity (i.e., a flow that will not allow particles to accumulate). For typical sewer diameters, a minimum velocity of 0.6 to 0.7 m/s during peak dry weather conditions should be adopted. A constant downhill gradient must be guaranteed along the length of the sewer to maintain self-cleansing flows, which can require deep excavations. When a downhill grade cannot be maintained, a **pumping station (/sswm-university-course/module-2-centralised-and-decentralised-systems-water-and-sanitation-1/pumping-stations)** must be installed. Primary sewers are laid beneath roads, at depths of 1.5 to 3 m to avoid damages caused by traffic loads. The depth also depends on the groundwater table, the lowest point to be served (e.g., a basement) and the topography. The selection of the pipe diameter depends on the projected average and peak flows. Commonly used materials are concrete, PVC, and ductile or cast iron pipes.

Access manholes are placed at set intervals above the sewer, at pipe intersections and at changes in pipeline direction (vertically and horizontally). Manholes should be designed such that they do not become a source of stormwater inflow or groundwater infiltration.

In the case that connected users discharge highly polluted wastewater (e.g., industry or restaurants), onsite pre- and primary treatment may be required before discharge into the sewer system to reduce the risk of clogging and the load of the wastewater treatment plant.

When the sewer also carries stormwater (known as a combined sewer), sewer overflows are required to avoid hydraulic surcharge of treatment plants during rain events. However, combined sewers should no longer be considered state of the art. Rather, local retention and infiltration of stormwater or a separate drainage system for rainwater are recommended. The wastewater treatment system then requires smaller dimensions and is, therefore, cheaper to build, and there is a higher treatment efficiency for less diluted wastewater.

Health Aspects/Acceptance

If well constructed and maintained, sewers are a safe and hygienic means of transporting wastewater. This technology provides a high level of hygiene and comfort for the user. However, because the waste is conveyed to an offsite location for treatment, the ultimate health and environmental impacts are determined by the treatment provided by the downstream facility.

Operation & Maintenance

Manholes are used for routine inspection and sewer cleaning. Debris (e.g., grit, sticks or rags) may accumulate in the manholes and block the lines. To avoid clogging caused by grease, it is important to inform the users about proper oil and grease disposal. Common cleaning methods for conventional gravity sewers include rodding, flushing, jetting and bailing. Sewers can be dangerous because of toxic gases and should be maintained only by professionals, although, in well-organised communities, the maintenance of tertiary networks might be handed over to a well-trained group of community members. Proper protection should always be used when entering a sewer.

Applicability

Because they can be designed to carry large volumes, conventional gravity sewers are very appropriate to transport wastewater to a (Semi-) Centralised Treatment facility. Planning, construction, operation and maintenance require expert knowledge. Construction of conventional sewer systems in dense, urban areas is complicated because it disrupts urban activities and traffic. Conventional gravity sewers are expensive to build and, because the installation of a sewer line is disruptive and requires extensive coordination between authorities, construction companies and property owners, a professional management system must be in place.

Ground shifting may cause cracks in manhole walls or pipe joints, which may become a source of groundwater infiltration or wastewater exfiltration, and compromise the performance of the sewer.

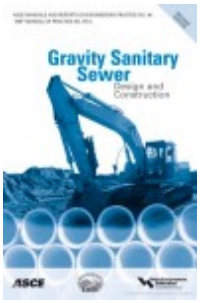
Conventional gravity sewers can be constructed in cold climates as they are dug deep into the ground and the large and constant water flow resists freezing.

Media PPT

Sewer Systems PPT (/media/90)

Library References

Gravity Sanitary Sewer Design and Construction. Second Edition



A standard design text used in North America. Local codes and standards should be assessed before choosing a design manual.

BIZIER, P. (2007): Gravity Sanitary Sewer Design and Construction. Second Edition. (= ASCE Manuals and Reports on Engineering Practice No. 60, WEF MOP No. FD-5). New York: American Society of Civil Engineers (ASCE)

Wastewater Engineering: Collection and Pumping of Wastewater

TCHOBANOGLOUS, G. (1981): Wastewater Engineering: Collection and Pumping of Wastewater. New York: McGraw-Hill

Sewers, Conventional Gravity

This factsheet deals with technical aspects of gravity sewers: applicability, advantages and disadvantages, design criteria, performance, O&M, costs, etc.

U.S. EPA (n.y): Sewers, Conventional Gravity. (= Collection Systems Technology Fact Sheets). United States Environmental Protection Agency (EPA) **URL (https://nepis.epa.gov/Exe/ZyNET.exe /P10053D9.TXT?ZyActionD=ZyDocument&Client=EPA& Index=2000+Thru+2005&Docs=&Query=&Time=&EndTime=& SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=& QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D**